

COMMUNICATION EFFICIENCY

FIELD

[0001] The invention relates generally to wireless access networks. More particularly, the invention relates to improving communication efficiency by enabling spatial channel reuse.

BACKGROUND

[0002] Wireless communication nodes, such as user terminals/stations and access points, may communicate with each other. Often the communication is performed on limited frequency resources. Therefore, channel spatial reuse may be used to increase the communication efficiency.

BRIEF DESCRIPTION OF THE INVENTION

[0003] According to an aspect of the invention, there are provided methods as specified in claims **1** and **6**.

[0004] According to an aspect of the invention, there are provided apparatuses as specified in claims **11** and **16**.

[0005] According to an aspect of the invention, there is provided a computer program product embodied on a distribution medium readable by a computer and comprising program instructions which, when loaded into an apparatus, execute the method according to any of the appended claims.

[0006] According to an aspect of the invention, there is provided a computer-readable distribution medium carrying the above-mentioned computer program product.

[0007] According to an aspect of the invention, there is provided an apparatus comprising means for performing any of the embodiments as described in the appended claims.

[0008] Embodiments of the invention are defined in the dependent claims.

LIST OF DRAWINGS

[0009] In the following, the invention will be described in greater detail with reference to the embodiments and the accompanying drawings, in which

[0010] FIG. **1** presents a network according to an embodiment;

[0011] FIG. **2** shows a signaling flow diagram according to an embodiment;

[0012] FIG. **3** shows a frame structure according to an embodiment;

[0013] FIGS. **4** and **5** illustrate methods according to some embodiments; and

[0014] FIGS. **6** and **7** depict apparatuses according to some embodiments.

DESCRIPTION OF EMBODIMENTS

[0015] The following embodiments are exemplary. Although the specification may refer to “an”, “one”, or “some” embodiment(s) in several locations of the text, this does not necessarily mean that each reference is made to the same embodiment(s), or that a particular feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments.

[0016] The number of IEEE 802.11-enabled mobile devices is increasing. The IEEE 802.11 is a set of standards for implementing wireless local area network (WLAN), also known as the Wi-Fi. Such an IEEE 802.11-enabled station (STA), such as user terminals/equipment **102-106** in FIG. **1**,

may associate and communicate with an access node/point (AP) **100**. The STAs **102-106** may comprise a mobile phone, a palm computer, a wrist computer, a laptop, a personal computer, or any device capable to access the wireless radio access network, such as the WLAN. The access node **100** may be a WLAN (IEEE 802.11) access point (e.g. Wi-Fi base stations), for example.

[0017] The AP **100** may perform communication with each of the STAs **102** to **106**. However, often this takes place on different frequency channels which is not most efficient with respect to the use of scarce frequency resources. Thus, due to the increased demands for communication efficiency, solutions for improving the communication efficiency and resource reuse are being analyzed. As one possibility, a cell sectorization technique is proposed. For example, cell sectorization techniques may reduce co-channel interference, enhance the quality of service (QoS), and increase the channel capacity.

[0018] Spatial reuse of the medium may be one of the mechanisms to be exploited in sectorized operation under Wi-Fi networks. However, the associated signalling to manage the sectorized technique may be a challenging issue. This is because the signalling may need be robust and support typical Wi-Fi scenarios, which may include coexistence of sophisticated multi-antenna Wi-Fi standards (e.g., IEEE 802.11n, IEEE 802.11ac and IEEE 802.11ah) with legacy Wi-Fi networks, and Overlapping Basic Service Set (OBSSs) at the same channels. In general, sectorized Wi-Fi has so far been achieved only in planned networks which include site planning, for example. This limitation may cause the channel spatial reuse in Wi-Fi networks to be poor in effectiveness and strongly dependent on the traffic load and the Clear Channel Assessment (CCA) thresholds used to identify if the channel is busy or not.

[0019] Therefore, there is provided a Wi-Fi signalling method to enable channel spatial reuse through sectorized operation. Let us consider a situation depicted in FIGS. **1** and **2** in which a node, such as the STA **102** has data to be sent to the AP **100**. The STA **102** may initiate the process by sending a signal to the AP in step **200A**. In an embodiment, the signal carries a request for data transfer with the AP **100**. The signal may be a single control frame requesting a transmission to a destination node (e.g., a ready-to-send (RTS) request/frame). A bit indicator in the RTS may be set to 0 to indicate that no additional control frame follows. In an embodiment, the signal is addressed to the AP **100**. Such addressing may be indicated in the header of the signal.

[0020] As the AP **100** receives the RTS signal from the STA **102**, the AP **100** may be called a target node of a wireless local area network whereas the STA **102** may be called a source node of the wireless local area network. However, it may be noted that in an embodiment, the target node **100** is not an access point (non-AP STA). This may be the case in a mesh networks, for example. Further, it may be noted that although so used in some embodiments, the source nodes **102** to **106** need not be non-AP STAs but may serve as APs (an AP STA). However, for the sake of simplicity, let us consider in the following that the target node **100** is an AP and the source nodes **102** to **104** are stations, such as STAs. In an embodiment, the target node is an access point of the IEEE 802.11. In an embodiment, the wireless access network is a wireless local area network of the IEEE 802.11. In an embodiment, the AP **100** and the STAs **102** to **106** all operate at least on a same specific frequency channel.